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MECHANICAL ENGINEERING

1. An experiment is carried out by a Biomedical Engineer using a certain type of bacteria that double in population every 5hrs in a growth if the experiment is commenced with 20 bacteria.

Solu

- a. Develop a model for the system

$$\frac{dy}{dt} = ky$$

$$\frac{dy}{y} = k dt$$

$$\ln y = kt + c$$

$$y = e^{kt+c}$$

$$y = e^c \cdot e^{kt}$$

$$e^c = y_0$$

$$y = y_0 e^{kt}$$

but ; $y = 2y_0$, when $t = 5\text{hrs}$
 $2y_0 = y_0 e^{kt}$

$$\ln 2 = 5k$$

$$k = \frac{(\ln 2)}{5} = 0.139$$

$$y = y_0 e^{0.139t}$$

- b. Use the model to estimate the population of the bacteria in 1½ day

Solu

$$24\text{hrs} = 1\text{day}$$

$$x = 1.5 \text{ day}$$

$$x = 24 \times 1.5$$
$$= 36 \text{ hrs}$$

$$\therefore \text{Where } y = 20, t = 36 \text{ hrs}$$

$$y = 20 \cdot e^{0.139 \times 36}$$

$$y = 2980.2$$
$$= 2980 \text{ bacteria.}$$

→ From the results derived, the population of the bacteria increases with time irrespective of the initial bacteria